

AMENDMENTS TO THE CLAIMS:

1. (Previously Amended) A driving apparatus for driving a piezoelectric element serving as a driving source of an actuator comprising:

a waveform generator for generating a waveform signal varying over time;

a first driver for generating a first driving signal, wherein the first driving signal has a maximum voltage smaller than a voltage of inversion of polarization of the piezoelectric element and has a first waveform derived from the waveform signal, the first driver being coupled to provide the first driving signal to the piezoelectric element in the polarization direction of the piezoelectric element; and

a second driver for generating a second driving signal, wherein said second driving signal has a maximum voltage smaller than the voltage of inversion of polarization of the piezoelectric element and has a second waveform derived from the waveform signal, the second driver being coupled to provide the second driving signal to the piezoelectric element in a direction opposite to the polarization direction;

wherein the first waveform is a polygon waveform and the second waveform is a polygon waveform.

2. (Previously Amended) A driving apparatus in accordance with claim 1, wherein the second waveform is an inversion of the first waveform.

3. (Cancelled)

4. (Previously Amended) A driving apparatus in accordance with claim 1, wherein the first and second waveforms are sawtooth waves in which the inclination in a rising portion is different from that in a falling portion.

5. (Previously Amended) A driving apparatus in accordance with claim 1, wherein the first driver and the second driver respectively include an amplifier for amplifying the signal from the waveform generator.

6. (Previously Amended) A driving apparatus in accordance with claim 1, wherein the actuator is an impact type actuator comprising a first unit with the piezoelectric element and a second unit slidably held on and relatively movable against the first unit.

Claims 7-16 (Cancelled)

17. (Previously Amended) A driving apparatus for driving a piezoelectric element serving as a driving source of an actuator comprising:

a first driver for applying a first time varying driving signal having a first waveform to the piezoelectric element in a polarization direction thereof; and

a second driver for applying a second time varying driving signal having a second waveform to the piezoelectric element equal to or smaller than a voltage of inversion of polarization of the piezoelectric element in a direction opposite to the polarization direction;

wherein the first waveform is a polygon waveform and the second waveform is a polygon waveform.

18. (Previously Amended) A driving apparatus in accordance with claim 17 further comprising an electric power supply for supplying electric power to the first and second drivers.

19. (Currently Amended) A driving apparatus for driving a piezoelectric element serving as a driving source of an actuator comprising:

a first driver for applying a first driving signal to the piezoelectric element in a polarization direction thereof;

a second driver for applying a second driving signal to the piezoelectric element equal to or smaller than a voltage of inversion of polarization of the piezoelectric element in a direction opposite to the polarization direction;

an electric power supply for supplying electric power to the first and second drivers; and

a waveform generator for generating a time varying signal, wherein only the first driver applies the first driving signal corresponding to the waveform of the time varying signal when the time varying signal is larger than a predetermined level; and

wherein both of the first and second driving signals correspond to the time varying signal when the time varying signal is smaller than the predetermined level.

20. (Previously Amended) A driving apparatus in accordance with claim 19, wherein the first and second driving signals are 0V when the time varying signal is equal to the predetermined level.

21. (Previously Amended) A driving apparatus in accordance with claim 19, wherein the waveforms of the first and second driving signals are sine waves.

22. (Previously Amended) A driving apparatus in accordance with claim 19, wherein the waveforms of the first and second driving signals are sawtooth waves in which the inclination in a rising portion is different from that in a falling portion.

23. (Previously Amended) A method for driving an actuator having a piezoelectric element serving as a driving source characterized by:

a first driving signal having a first waveform and having a maximum voltage smaller than a voltage of inversion of polarization of the piezoelectric element is applied to the piezoelectric element in a polarization direction of the piezoelectric element; and

a second driving signal having a second waveform and having the same voltage but the inverted polarization is applied to the piezoelectric element in a direction opposite to the polarization direction of the piezoelectric element;

wherein the first waveform is a polygon waveform and the second waveform is a polygon waveform.

24. (Previously Amended) A method in accordance with claim 23, wherein the second waveform is an inversion of the first waveform.

25. (Cancelled)

26. (Previously Amended) A method in accordance with claim 23, wherein the first and second waveforms are sawtooth waves in which the inclination in a rising portion is different from that in a falling portion.

27. (Currently Amended) A driving apparatus for driving a piezoelectric element serving as a driving source of an actuator comprising:

a waveform generator for generating a waveform signal varying over time;

a first driver for generating a first driving signal, wherein the first driving signal has a maximum voltage smaller than a voltage of inversion of polarization of the piezoelectric element and has a first waveform derived from the waveform signal, the first driver being coupled to provide the first driving signal to the piezoelectric element in the polarization direction of the piezoelectric element; and

a second driver for generating a second driving signal, wherein said second driving signal has a maximum voltage smaller than the voltage of inversion of polarization of the piezoelectric element, has a maximum voltage approximately equal to the maximum voltage of the first driving signal and has a second waveform derived from the waveform signal, the second driver being coupled to provide the second driving signal to the piezoelectric element in a direction opposite to the polarization ~~direction~~ direction,

wherein the first and second waveforms are sine waves.

28. (Previously Added) A driving apparatus in accordance with claim 27, wherein the second waveform is an inversion of the first waveform.

29. (Cancelled)

30. (Cancelled)

31. (Previously Added) A driving apparatus in accordance with claim 27, wherein the first driver and the second driver respectively include an amplifier for amplifying the signal from the waveform generator.

32. (Previously Added) A driving apparatus in accordance with claim 27, wherein the actuator is an impact type actuator comprising a first unit with the piezoelectric element and a second unit slidably held on and relatively movable against the first unit.

33. (Previously Added) A driving apparatus for driving a piezoelectric element serving as a driving source of an actuator comprising:

a waveform generator for generating a waveform signal varying over time;

a first driver for generating a first driving signal, wherein the first driving signal has a maximum voltage smaller than a voltage of inversion of polarization of the piezoelectric element and has a first waveform derived from the waveform signal, the first driver being coupled to provide the first driving signal to the piezoelectric element in the polarization direction of the piezoelectric element; and

a second driver for generating a second driving signal, wherein said second driving signal has a maximum voltage smaller than the voltage of inversion of polarization of the piezoelectric element and has a second waveform derived from the waveform signal, the second driver being coupled to provide the second driving signal to the piezoelectric element in a direction opposite to the polarization direction;

wherein the second waveform is an inversion of the first ~~waveform~~ waveform and
wherein the first and second waveforms are sine waves.

34. (Cancelled)

35. (Cancelled)

36. (Previously Added) A driving apparatus in accordance with claim 33, wherein the first driver and the second driver respectively include an amplifier for amplifying the signal from the waveform generator.

37. (Previously Added) A driving apparatus in accordance with claim 33, wherein the actuator is an impact type actuator comprising a first unit with the

piezoelectric element and a second unit slidably held on and relatively movable against the first unit.

38. (New) A driving apparatus for driving a piezoelectric element serving as a driving source of an actuator comprising:

a waveform generator for generating a waveform signal varying over time;

a first driver for generating a first driving signal, wherein the first driving signal has a maximum voltage smaller than a voltage of inversion of polarization of the piezoelectric element and has a first waveform derived from the waveform signal, the first driver being coupled to provide the first driving signal to the piezoelectric element in the polarization direction of the piezoelectric element; and

a second driver for generating a second driving signal, wherein said second driving signal has a maximum voltage smaller than the voltage of inversion of polarization of the piezoelectric element, has a maximum voltage approximately equal to the maximum voltage of the first driving signal and has a second waveform derived from the waveform signal, the second driver being coupled to provide the second driving signal to the piezoelectric element in a direction opposite to the polarization direction,

wherein the first and second waveforms are sawtooth waves in which the inclination in a rising portion is different from that in a falling portion.

39. (New) A driving apparatus in accordance with claim 38, wherein the second waveform is an inversion of the first waveform.

40. (New) A driving apparatus in accordance with claim 38, wherein the first driver and the second driver respectively include an amplifier for amplifying the signal from the waveform generator.

41. (New) A driving apparatus in accordance with claim 38, wherein the actuator is an impact type actuator comprising a first unit with the piezoelectric element and a second unit slidably held on and relatively movable against the first unit.

42. (New) A driving apparatus for driving a piezoelectric element serving as a driving source of an actuator comprising:

a waveform generator for generating a waveform signal varying over time;

a first driver for generating a first driving signal, wherein the first driving signal has a maximum voltage smaller than a voltage of inversion of polarization of the piezoelectric element and has a first waveform derived from the waveform signal, the first driver being coupled to provide the first driving signal to the piezoelectric element in the polarization direction of the piezoelectric element; and

a second driver for generating a second driving signal, wherein said second driving signal has a maximum voltage smaller than the voltage of inversion of polarization of the piezoelectric element and has a second waveform derived from the waveform signal, the second driver being coupled to provide the second driving signal to the piezoelectric element in a direction opposite to the polarization direction;

wherein the second waveform is an inversion of the first waveform and wherein the first and second waveforms are sawtooth waves in which the inclination in a rising portion is different from that in a falling portion.

43. (New) A driving apparatus in accordance with claim 42, wherein the first driver and the second driver respectively include an amplifier for amplifying the signal from the waveform generator.

44. (New) A driving apparatus in accordance with claim 42, wherein the actuator is an impact type actuator comprising a first unit with the piezoelectric element and a second unit slidably held on and relatively movable against the first unit.